COMMONWEALTH OF VIRGINIA

Department of Environmental Quality

Subject: Division of Land Protection and Revitalization Guidance Memo
LPR-SW-SI-19
SUBMISSION INSTRUCTIONS FOR GROUNDWATER ALTERNATE SOURCE DEMONSTRATIONS AT SOLID WASTE LANDFILLS

To: Regional Land Protection and Revitalization Program Managers

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Copies: Regional Directors

Summary

This guidance provides owner/operators of regulated solid waste management facilities with an overview of the information applicable to the development and submission of an Alternate Source Demonstration at solid waste sites undergoing groundwater monitoring in accordance with 9 VAC 20-81-250 of the Virginia Solid Waste Management Regulations (VSWMR). An Alternate Source Demonstration is one of the available regulatory mechanisms to address 'suspect' groundwater exceedances over site-specific background levels or groundwater protection standards.

Electronic Copy

An electronic copy of this guidance applicable to solid waste sites is available on DEQ's website at http://www.deq.virginia.gov/waste/guidance.html.

Contact Information

Owner/operators who wish to submit an Alternate Source Demonstration to address a groundwater exceedance are encouraged to contact their respective Regional Office to discuss a work plan prior to starting the demonstration. Please contact the groundwater program coordinator, Mr. Geoff Christe at (804) 698-4283 or via email geoff.christe@ deq.virginia.gov with any questions regarding the development or application of this guidance.

Disclaimer

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any alternative method. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Submission Instruction

Groundwater Alternate Source Demonstrations

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I - APPLICABILITY

This Submission Instruction (SI) is applicable to all solid waste management facilities conducting groundwater monitoring under the requirements of the Virginia Solid Waste Management Regulations (VSWMR), originally promulgated by the Virginia Waste Management Board December 21st, 1988; as amended. The SI has been designed in a manner consistent with the regulatory language in Amendment 7 of the VSWMR, effective March 16th 2011 and it supersedes SI previously issued by the Department in August of 2004.

II - DEVELOPMENT

This SI has been developed to assist an owner/operator in the preparation of Alternate Source Demonstrations (ASD). The SI references technical information contained in four EPA guidance documents listed in the References section of this SI and provides an outline of the suggested minimum technical content that should be included within an ASD submitted for Department review. It is ultimately the responsibility of the Permittee to include all the data or information necessary to sufficiently support each of the final conclusions.

These SI have not been developed as Department rule or policy. They have not gone through public comment. They do not supersede any regulatory requirement found in the VSWMR and their use is not mandatory under the current regulations. The Department recognizes that these SI may need to be altered to fit facility-specific geologic or hydrologic conditions that cannot be adequately accounted for in the SI. It is expected that the final content of any ASD submitted to the Department will likely include one or more site-specific considerations.

All SI are considered 'living' documents which will be updated or revised as needed. Comments or suggestions for future SI revisions can be submitted at any time to the attention of the Solid Waste *Groundwater Program Coordinator* at the address listed on the cover of this SI.

III - LIMITATIONS/DISCLAIMER

EPA defined the scope and purpose of the ASD provision within the Subtitle D solid waste regulations [*40 CFR 258.54.(c).(3)* and *55.(g).(2)*]. Because EPA is the source of the ASD provision, these SI contain references to EPA's commentary in its *preamble* to the Subtitle D regulations and its 1993 Subtitle D regulation guidance. EPA's preamble contains its expanded interpretation of the technical content in 40 CFR 258 and addresses the response to public comment received during the draft regulation process.

Although EPA's preamble language is referenced within this SI, preamble

language is not a binding part of a law/statute and it can neither enlarge the scope of a statute's applicability nor confer powers to the regulatory authority not already expressly contained within the language of the statute. At the same time, if there is some question behind the intent or meaning of any portion of the Subtitle D statute text, and the preamble addresses the question, the content of the preamble cannot be ignored if it addresses the ambiguity raised. The 1993 Subtitle D regulatory guidance developed by EPA expands further upon the content of the preamble, but has the same limitations in that guidance cannot be used to infer requirements that are not expressly part of the Subtitle D statute.

IV - TECHNICAL CONSIDERATIONS

ASDs are technical demonstrations that require conclusions be supported by site-specific facts. The submission (defined by EPA) is a 'demonstration'. As such, it should not contain hypothetical statements or conjecture-based conclusions.

The development of a successful ASD often requires additional site work to gather the required field evidence. As a result, ASDs may have significant cost and technical hardship associated with them. Any owner/operator considering an ASD work plan should balance the cost of undertaking such action (and any future revisions to such action) with the cost associated with simply modifying the monitoring program as otherwise required in the VSWMR or pursuing other options to address the exceedance such as: verification sampling, background redevelopment, or an Alternate Point of Compliance variance.

An effective ASD must show: a] that there is an identified source other than the landfill (or) on site natural variability, (or) an error during sampling, analysis or data reduction efforts which was ... b] the cause of the suspect groundwater sampling exceedance. EPA's 1993 Subtitle D guidance defines the relevant individual lines of evidence an owner/operator should pursue. EPA also noted the ASD should be documented (prepared) and certified (signed) by a qualified groundwater scientist. The VSWMR additionally require the ASD be completed within a defined timeframe after recognition of a statistical exceedance and be addressed to the Director as a standalone submission, not part of another routine groundwater submission such as an Annual, Semi-annual or Quarterly Report.

While use of these SI may assist the owner/operator in development of a complete ASD, use of the SI does not imply any guarantee of final content approval.

Discussion of the use of the 'error in ...' ASD provision

EPA recognized that several types of error may occur during the various stages of groundwater sampling, analysis and statistical interpretation which could lead to a result which is not a true representation of groundwater conditions (pg

281 of EPA's 1993 Subtitle D guidance):

> *"A successful demonstration that the statistically significant change is the result of an error in sampling, analysis, or data evaluation may include the following:*
>
> - *clear indication of transcription or calculation error*
> - *clear indication of a systematic error in analysis or data reduction*
> - *resampling, analysis, and evaluation of results*
> - *corrective measures to prevent the recurrence of the error and incorporation of these measures into the groundwater monitoring program."*

Sampling Error

While none of EPA's specific bullet points above address error in field *sampling*, the Department considers such an error to potentially cover any field actions that may contribute to analytical results that do not represent actual groundwater quality. Such errors may include incomplete well purging or over purging a well (to dryness), a sediment-filled well bore yielding turbid samples, cross contamination during sampling actions, incorrect sample preservation methods, or improper sample handling or shipping procedures.

When excessive turbidity is raised as the cause of the suspect result, the facility must supply the site-specific NTU data (readings) taken at the time of the suspect sampling event at the exceeding well. The effects of turbidity cannot be inferred without providing the appropriate supporting field data that clearly demonstrates turbidity levels were present outside the normal or expected range historically registered at the site.

If turbidity-based ASD approval is granted, the Director will typically require that the facility alter the sampling procedure to limit the problem from arising again and this is consistent with requirements of *9 VAC 20-81-250.A.3.e* which require monitoring wells be able to perform to design specifications throughout the duration of the monitoring program. At the time of installation, monitoring wells are free of accumulated sediment. If the well is not periodically cleaned of collected fines (sediment) during its lifespan, the sediment could become suspended in the water column during groundwater sampling and entrainment of suspended sediment could lead to metals concentrations higher than those present naturally within the aquifer because the groundwater transmitting zones (pore space or secondary porosity features such as fractures and bedding planes) do not contain a similar accumulation of concentrated precipitated fines.

If NTU field readings are not available for the suspect event, the Permittee may still be able to demonstrate excessive sediment has caused elevated metals results by proving that: a] sediment has in fact collected at the base of the well, post well-installation, by comparing historical and current total well depth measurements, and b] acquire a sample the sediment to show the suspect metal(s) in the groundwater sample is also present within the collected well sediment sample.

Verification Sampling

With respect to groundwater re-sampling, EPA's 1993 guidance noted an ASD could include:

> *"Resampling and analysis to verify the presence and concentration of the constituents for which the increase was reported."*

This type of sampling action is referred to as *verification sampling* in *9 VAC 20-81-250.A.4.* While EPA considered this evidence line applicable to ASD submissions, the Department (in an effort to reduce the number of ASDs that need to be submitted) doesn't require verification sampling be submitted in an ASD form if:

- verification sampling is completed within the 30-day statistical analysis window defined under *9 VAC 20-81-250.A.4.h.(2)* and
- the verification sampling completed within 30 days of receipt of the laboratory certified analytical data also refutes the original suspect exceedance.

If both conditions are met, the verification results can be reported in the routine semi-annual or quarterly monitoring report which will include the lab results for both the original sampling event and the verification event. If verification sampling cannot be completed within the 30 days noted above or the verification results do not initially refute the exceedance, then the results will need to be submitted in an ASD format and the provision noted on Page 281 of EPA's Subtitle D guidance (see below) will typically apply:

> *"More than one sample may be required to substantiate the contention that the original sample was not representative of the groundwater quality in the affected well(s)."*

If multiple samples are required to show the original statistical exceedance was suspect, they should be obtained statistically independent of one another (current guideline is at least 30 days apart unless groundwater flow rate on site is unusually high). The Department will not accept samples obtained within timeframes that do not prove sample independence. Any ASD submitted based on multiple re-sampling should focus on use of "error in statistical analysis" provision (discussed in further detail below).

Laboratory Analytical Error

Concerning the error in *laboratory analysis* allowance, if this provision will be part of the ASD, it is the analytical laboratory which must identify (or admit to) the error or failure in equipment or data transcription. This finding must be certified/signed by the laboratory director or QA/QC manager. A third party (i.e., independent consultant) cannot prove a lab error in absence of the laboratory acknowledging the error. Consistent with EPA's 4th bullet item above, the Department will look for proof that preventative measures have been taken by the lab to lessen the chance the error will occur again.

Statistical Error

When an exceedance is caused by an error in *statistical analysis*, the owner/operator will need to identify the calculation error(s) that occurred. The Department recommends the owner/operator utilize the most recent DEQ groundwater statistical guidance when undertaking comparisons to GPS or site background, as well as EPA's 2009 Unified Guidance document which covers statistical applications to groundwater data in great detail.

Use of the 'Other Source' provision

Page 280 of EPA's 1993 Subtitle D guidance listed several lines of evidence EPA was looking for from an owner/operator when another source was being claimed as the cause of the groundwater exceedance. These lines of evidence were to document:

1. an alternate source exists,
2. a hydraulic connection between the alternate source and the affected well is present,
3. alternate source constituents exist along a flow path to the affected well,
4. constituent concentrations increase toward the alternate source,
5. constituent concentrations from the alternate source are historically consistent with findings of the monitoring program, and
6. suspect constituents could not have resulted from the MSWLF given leachate and waste characteristics and site hydrologic conditions.

The Department typically only requires an ASD address the first three evidence

items above. The 4th and 5th line items could involve installation of additional wells which, based on the associated cost, may only be required in site-specific instances to ensure a cost burden is not unnecessarily applied to all owner/operators without valid technical basis.

As an example of how evidence lines 1 - 3 may work together, if a monitoring well displays a suspect detection of benzene and the landfill is located adjacent to a gas station (or some other petroleum handling facility); the mere presence of an adjacent gas station is not reason alone for ASD approval. The ASD must also demonstrate that the gas station lies: a] hydrologically upgradient of the affected well(s) on the landfill site, and b] the gas station has a documented petroleum release (which is the cause of the exceedance on the landfill property). Failure to co-demonstrate 'a' and 'b' is the most common cause for ASD non-approvals.

Differing Approaches for Subtitle D vs. non-Subtitle D Landfills

It is important to understand that 40 CFR 258 (and its related guidance) was designed for new landfills constructed to meet Subtitle D design criteria. As a result, some of EPA's ASD evidence lines are not conducive for application at unlined landfills. For instance, the use of *leachate sampling* results as part of ASD development (under line item #6 above) is one of the allowances that is a poor fit for unlined landfills and it's not recommended that a Permittee spend resources on attempting to collect this line of evidence. While the Department recognizes some unlined landfills have installed leachate interceptor trenches around the perimeter of the waste mass, these features cannot (because of their design) intercept all leachate released to the aquifer from the waste mass. Sampling results obtained from the perimeter of a waste mass (via leachate interceptor trenches) cannot be considered representative of the entire contaminant chemistry of a waste mass that often will contain multiple cells of different disposal ages and solid waste characteristics. In addition, the lack of 'recent' leachate generation at closed unlined landfills plays no significant role in ASD approval as if historic releases (during the active life of the facility) impacted the aquifer above regulatory standards, the impact must be addressed (regardless of whether the landfill is *currently* generating or releasing leachate to the aquifer).

Limitations on 'Other' sources

- LFG

Landfill gas (LFG) generated within the waste mass as a byproduct of putrescible waste decay does not meet the definition of "other" source under the ASD allowance because LFG is derived from (thus caused by) material within the waste mass. If it acts as a transport mechanism to bring landfill VOCs into contact with groundwater, the resulting impairment must be addressed. In many cases, LFG impacts to groundwater can be addressed via the implementation of an LFG

management/remediation plan even if the LFG levels on site otherwise do not trigger LFG remedial actions separately under the VSWMR. If these remedial efforts are successful, further (and costly) requirements concerning groundwater corrective action may not be required. In situations such as these, contact with the Regional Office should be initiated to discuss the appropriate compliance mechanisms under which such actions can be undertaken.

- **Significance of Dissolved Metals**

Dissolved metals sampling results play no significant role in ASD approvals at unlined landfills because the VSWMR require all regulatory decisions regarding groundwater impacts be based on non field filtered, *total* metals analytical data (*9 VAC 20-81-250.A.4.b*). This VSWMR requirement is consistent with that noted in EPA's Subtitle D rule and described in the Subtitle D preamble [56 FR 51074]:

> *"... background concentrations ... will be established on the basis of unfiltered samples (as are MCLs) thereby providing a consistent comparative basis for data evaluation ..."*

EPA took this position while acknowledging that all unfiltered groundwater samples will be expected to contain some metals present in the form of insoluble colloidal particles (since metals are either insoluble or nearly insoluble in groundwater). If filtering (removing this particle size fraction) prior to analysis takes place, the analytical result will likely under report the actual concentration of total metals in groundwater moving through the aquifer system (potentially affecting receptors). EPA noted this concern in 56 FR 51074 as follows:

> *"... filtration of groundwater samples for metals analyses will not provide accurate information concerning the mobility of metal contaminants. Some mobile metal contaminants move through fractured, karstic, and porous media ... as precipitated phases, polymeric species, or adsorbed to inorganic or organic particles (e.g., colloids) that are likely to be removed by filtration."*

While dissolved metals data is not accepted in ASDs submitted for unlined landfills, it may have some very limited applications in ASDs submitted for lined Subtitle D facilities if it is paired with other forms of geochemical aquifer data that record a non-liner related failure in facility component(s). As an example, there have been cases of leachate collection line rupture or landfill gas condensate line leaks that have released leachate into the vadose zone. While the quantity of the leachate or condensate released may be insufficient to enter the groundwater table,

it may still affect the geochemistry of the vadose zone matrix which may lead to the release of reduced-form metals (which may enter the aquifer in the 'dissolved' form). Use of dissolved metals sampling data may have an application if it can be tied specifically to areas downgradient of the landfill component failure(s). Contact with the Regional Office should be initiated prior to spending money on the collection of dissolved metals sampling data during ASD development.

- **Use of Soils Sampling Data**

ASDs sometimes include sampling of site soils (i.e., generally by hand auger methods from 0 – 6 feet below ground surface) as part of an ASD in either the 'natural' metals context (discussed later in this SI) or as proof of a source other than the landfill. Soil sampling data are excluded from this SI discussion because very few of the monitoring wells associated with landfills in the Commonwealth are screened in a soil (as defined geologically - not from an agricultural science or geotechnical engineering standpoint). Soil, as the term is used herein, is a material that has been created dominantly through secondary, biologically induced or influenced processes, or via agricultural modification. Soil does not retain (as does saprolite for instance) all the structural or compositional characteristics of its parental (underlying) source material. Thus, metals concentrations in soil near the ground surface (i.e., lead, mercury, sulfides) may be quite different from those present in the underlying, unmodified, geologic matrix of the aquifer as a result of the addition of (non-site derived) material to the soil by atmospheric fallout (both dust, pollutants, and precipitation), transitory animals (waste products, carcass decay), and anthropomorphic activities (agricultural, commercial, industrial).

While any or all of these actions may demonstrably add non-site derived metals to surficial soils (i.e., metals not present in the underlying aquifer matrix), these 'added' metals should not impact the groundwater monitoring system at the landfill since (as pointed out by EPA in its 1992 Groundwater Issue Paper):

> *"Metals added to soil will normally be retained at the soil surface. Movement of metals into other environmental compartments, i.e., groundwater, ... should be minimal as long as the retention capacity of the soil is not exceeded."*

Therefore, simple presence of a metal in site soils cannot be interpreted as an alternate 'source' for the same metal showing up in exceeding wells downgradient of the waste mass unless vertical transport of said metal is demonstrated. It is important to also note that in those limited situations in the Commonwealth were groundwater monitoring systems are installed at very shallow depths (due to proximity of the groundwater table to the land surface), the fact that all wells on such sites are installed to similar shallow depths means the upgradient vs.

downgradient metals concentration comparisons in the groundwater program will be completed on data obtained from the same matrix material allowing for valid statistical comparisons.

- **Interpretation of Collected Sediment**

As previously discussed in this SI, sediment accumulations (sediment precipitated within the well bore) after well installation are often listed as a reason for the suspect exceedance in metals concentrations. In addition to such sediment being listed as the cause of turbidity issues (previously discussed in this SI), the Department has also seen the presence of sediment in the well being presented as proof of the presence of 'natural', non-landfill derived metals in the groundwater samples. Such submissions fail to describe how the sediment in the well was determined to be 'natural' since groundwater analysis undertaken for the solid waste program using EPA SW-846 methods cannot differentiate between the forms a metal may be found in (natural mineral form vs. manmade crystalline / industrial form). This is important because EPA has already acknowledged in its 1992 Ground Water Issue technical paper and its 1993 Subtitle D guidance that metals in groundwater will typically move through the aquifer system as colloids. Landfill leachate also typically contains elevated total dissolved and suspended solids (TDS & TSS) which would be rich in colloid-sized particles. Such leachate-derived colloids can precipitate in the base of the well just as easily as aquifer-derived colloid-sized minerals can. Because of the analytical limitations of SW-846, it is thus not possible to sample well sediment and then differentiate whether the sediment is solely landfill derived, solely precipitated metal-containing colloids derived from the native aquifer matrix, or a combination of both unless expensive, non SW-846 analytical techniques are employed. As a result, the Department cautions against ASD submissions using this line of evidence collection.

Use of the Natural Variation provision

Concerning natural geologic variation on site, EPA noted (within pgs 220 – 239 of its 1993 Subtitle D guidance) that:

> *"... samples collected from both upgradient and downgradient locations prior to waste disposal can be used to establish background water quality. The sampling should be conducted to account for both seasonal and spatial variability in groundwater quality."* And, *"... background groundwater quality may be determined by sampling wells that provide groundwater samples as representative or more representative than those provided by upgradient wells. These conditions may include the following: ... geologic units present at downgradient locations are absent at upgradient locations."*

EPA further noted the importance of ensuring that all wells within a monitoring system were screened in the same geologic lithology (in order to ensure correct application of statistics), noting (pgs 221 and 222):

> *"The natural chemical composition of groundwater is controlled primarily by the mineral composition of the geologic unit comprising the aquifer. To reduce the probability of detecting naturally occurring differences in groundwater quality between background and downgradient locations, only groundwater samples collected from the same geologic unit should be compared."*

If an owner/operator follows EPA's performance requirements for aquifer characterization and installs a well network that accurately reflects natural geologic variability and intercepts groundwater samples from the same water bearing unit; the issue of geologic spatial variability (as a cause for the suspect exceedance) should not affect the site. On the other hand, owner/operators who have chosen to install only a single background well on site may find that background metals calculations derived from this single well will be unable to address the true range of background metals present. In such cases, spatial variability could lead to potential suspect exceedances in downgradient wells.

Natural (non geology based) variation in groundwater quality may also result from simple variations in seasonal precipitation patterns which govern the amount of 'fresh' recharge entering the local aquifer system. EPA in its Subtitle D guidance (pg. 226) required ...:

> *"The owner/operator should determine and assess: seasonal/temporal, natural, and artificially induced ... short term and long term variations in groundwater elevations and flow patterns."*

In Virginia, such climactic effects may lead to significant fluctuations in the groundwater table elevation in Coastal Plain settings and temporal pulses of increased groundwater flow within Karst conduit systems in carbonate bedrock aquifers. Each may lead to increases in total metals concentrations within groundwater samples as a result of mobilizing metal containing compounds which had formerly precipitated in the capillary fringe of the aquifer matrix during low-stands in the groundwater table, or by picking up greater proportions of colloids formerly at rest along the base of conduit systems during periods of relatively slow (low) groundwater flow rates.

Landfills that utilize groundwater pumping (gradient control) systems to keep the groundwater table below the base of the waste mass as such actions may also introduce a similar (simulated climactic) affect on the aquifer if the pumping rate varies during, or from year to year, and this change also triggers marked alterations in the elevation of the groundwater table or changes in groundwater flow patterns.

If climatic (or operational) effects are determined to be the cause of a seasonally-based variation in metals data, such conclusions must be based on a demonstrated correlation between elevated sampling results and variations in precipitation and groundwater elevation data recorded on site. Precipitation data, if not site-specific, should be obtained from the closest NOAA or NWS station. In the gradient control example, pumping rates should be available on a consistent basis. ASD approval, if granted, may be accompanied by a Department request to modify the monitoring well network which, in Coastal Plain settings, most commonly would be the deepening of the compliance wells such that the screened interval lies below the seasonal low water table at all times during the year or by modifying the sampling schedule to alleviate the problem as much as possible.

It is important to note that if the owner/operator intends on using spatial/natural variability as a means for obtaining ASD approval, he or she would also be conceding that the existing monitoring network is unable to fully account for the noted variability on site. While ASD approval may be granted, this aspect of network non-conformance will require additional site actions by the owner/operator to meet the performance standards of *9 VAC 20-81-250.A.5.c.(2)*. It will not be possible to continue to use the same deficient network design demonstrated to be unable to account for variability on site.

Naturally Occurring metals

Each metal on the VSWMR Table 3.1 sampling list is a naturally occurring metal (i.e., it cannot be created artificially in a lab). However, not all of these metals will be found naturally in each and every geologic setting within the Commonwealth. At site where the owner/operator has correctly characterized site geology and has an appropriate number of monitoring wells in place to have accurately determined site background, the Department interprets the metals sampling data from the upgradient wells to accurately reflect the concentrations of metals naturally present in the aquifer on site.

It is also interesting to note that EPA's 1993 Subtitle D guidance does not refer to, or use the term 'natural metals' with respect to its ASD discussion. Despite that, many of the ASDs submitted to the Department attempt to demonstrate that exceeding levels of metals (i.e., those above the statistically

calculated natural background derived from upgradient wells) in wells downgradient of a lined or unlined waste mass simply reflect metals concentrations naturally present in the aquifer. ASDs which contain this claim of metals seen at downgradient exceeding levels being 'natural' typically fail to show how this 'natural' characteristic was demonstrated and fail to note why the metal in question cannot have been part of the waste material in the landfill.

EPA used the documented presence of metals in landfill leachate when defining the Subtitle D sampling list as noted in the *preamble*:

> *"... antimony, beryllium, cobalt, thallium and vanadium* (were added) *to the required metals in Appendix I ... because they are representative of MSWLF leachate."*

Other metals were added to the list based on remediation sampling data obtained from RCRA C sites. It was this understanding that solid waste can contain a wide variety of waste materials which can contain metals that caused EPA to require landfill owner/operators have a sampling program that would be able to recognize potential metals impact on aquifer quality. EPA found no evidence for a geochemical process that would prevent metals from leaching from waste and leaving the base of a landfill (via liner failure in the case of a Subtitle D facility).

Once landfill derived metals are released into the aquifer, EPA noted in both its 1992 Ground Water Issue technical paper and its Subtitle D preamble that:

> *"Transport of metals associated with various waste may be enhanced due to ... 1] facilitated transport caused by metal association with mobile colloidal sized particles, 2] formation of metal organic and inorganic complexes that do not sorb to soil solid surfaces ... ."*
>
> *"... metals may undergo facilitated transport phenomenon through the sorption to colloidal particles. This process makes metals more mobile in groundwater than previously thought."*
>
> *"Changes in the soil environment over time, such as the degradation of the organic waste matrix, changes in pH, redox potential, or soil solution composition, due to ... natural weathering processes also may enhance metal mobility."*

In contrast to EPA's understanding of the behavior of waste mass metals,

ASDs submitted to the Department with the claim that all exceeding metals concentrations recognized in downgradient wells are simply natural metals are asserting the counter-claim that metal(s) in the waste mass cannot have been released to the aquifer. Such submissions rarely obtain Department approval because they fail to demonstrate how the aquifer (an inanimate entity that can only 'react' to external geochemical stimuli) 'causes' a sudden increase in metals concentrations (or long-term upward trend) only seen: a] in areas downgradient of the waste mass and b] only after the landfill began to receive waste. This is an important consideration as EPA [*40 CFR 258.54.(c).(3)*] required that a successful ASD: *"... demonstrate that a **source** other than a MSWLF unit **caused** the contamination ..."*. Using arsenic as an example, while it may be present within minerals in the aquifer matrix, it may additionally be present in waste within the landfill. Therefore, an increase in arsenic groundwater concentrations downgradient of a landfill may be caused by:

- a change in downgradient redox conditions which could trigger reduction of mineral-containing Fe(III) to Fe(II) with the concomitant release of any metals (such as arsenic) that had been adsorbed to the Fe(III) resulting in an increase in arsenic concentrations in groundwater, or ...
- arsenic could be released from the base of the landfill as a colloid within leachate causing the increase in concentration levels in downgradient wells.

In both scenarios, it is important to recognize that the landfill is the ultimate cause of the arsenic problem by either altering the natural geochemistry of the aquifer which in turn enhances mineral sourced mobility, or by simply releasing the leached metal from waste. There is no ASD '*waiver*' under which an owner/operator is relieved of the responsibility of addressing metals increases (and the potential risk to downgradient receptors) solely because the metal in question may also exist naturally in the aquifer matrix. Had the landfill not altered the groundwater chemistry downgradient of its footprint, arsenic would not have become mobilized within the aquifer system and when addressing environmental exposure risks. It is important to also acknowledge that Federal MCLs (as well as other risk-based exposure standards) are applied to receptors regardless of whether the MCL metal originates in mineral-form or as a commercially made industrial compound discarded as solid waste in a landfill.

When reviewing ASDs claiming downgradient metals exceedances are not caused by the landfill or by some error in sampling, analysis or statistics, the Department believes only one of two scenarios exist:

1. In the case of lined Subtitle D landfills, the downgradient results are a valid reflection of aquifer metals concentrations in those cases where there is no other evidence of a historic/current leachate release and the metals concentrations over time have been stable suggesting the landfill is not

affecting the natural geochemistry of the aquifer downgradient of the waste mass. In this scenario, if the landfill was not here, one would still see the same metals problem.

However, instead of ASD approval given based on a concept of 'natural' metals, the Department would likely approve for natural variability (as discussed previously in this SI) with the current upgradient well(s) being now demonstrated as insufficient to provide an accurate representation of natural (non-landfill impacted groundwater). The network non-conformance with *A.3.a.(1)* performance standards would require modification of the network to address the variability as a condition of ASD approval.

2. The downgradient results reflect either a landfill release impacting downgradient wells (at unlined landfills), or a landfill-related geochemical impact on the downgradient aquifer (at lined or unlined landfills) where geochemical conditions are acting to mobilize metals in minerals within the aquifer matrix below the waste footprint, driving them toward the downgradient monitoring points. In this scenario, if the landfill was not there, you would not see the same metals problem. In these cases, ASD submittal would not be warranted as approval would be unlikely. A better option for addressing the exceedance would be a request for Alternate Point of Compliance variance (if the applicable site conditions are present).

V - WORKPLAN PRE-APPROVAL

9 VAC 20-81-250.A.5 does not require a Permittee obtain Department pre-approval before undertaking ASD actions. However, it is strongly recommended that a Permittee meet with the Department to discuss the proposed work prior to undertaking ASD actions as a means of potentially reducing any unnecessary cost associated with work which may not meet the criteria needed for submission approval. Because the work associated with potential ASDs is time consuming and may be expensive, prior to moving forward with any ASD work, especially at unlined landfills, owner/operators should carefully review the following questions:

- are the 'suspect' metals present in wells which historically or currently display quantifiable levels of VOC(s) indicating the sampling point intercepts groundwater that had (or has) a leachate component? If so, attempting to prove the metal concentration(s) or VOC's are not sourced within (or caused by) the landfill may be extremely difficult and cost prohibitive to pursue.

- are the metals present in wells which have never historically or currently displayed quantifiable levels of VOC(s) which suggests that the sampling point does not intercept groundwater that had or has a leachate component? If so, do long-term concentration trends of the suspect metal(s) show

stability? If a regression analysis indicates the trends are not neutral, then the metal concentrations are likely caused by the landfill since those same upward (or unstable) trends are NOT observed in the 'clean' upgradient well(s) for the metal in question.

- if the regression analysis indicates the trends are neutral, then the metal may be naturally present and its failure to be recognized in the upgradient well(s) indicates the network does not have the ability to fully address natural variability of the aquifer. In lieu of an ASD, the Permittee would be better served to first install additional background data collection points and use that data to show that the earlier recognized exceedance was based on an inaccurate background calculation (error in statistical analysis provision). Regardless of whether or not new background wells are installed upfront or after ASD submittal, as noted above, they will be required by the Director under *9 VAC 20-81-250.A.5.c.(2).(a)* as a means of ensuring compliance with upgradient aquifer and background determination requirements of *9 VAC 20-81-250.A.3.a.(1)* and *4.d.*

With respect to unlined landfills, the Department will retain the right to view sampling results on a case by case basis as there may be times where although metals concentrations exceed their background based GPS, if the recent history (i.e., 5 years) suggests development of a stable trend, it could be argued that the metals (although not reflective of natural conditions) are now in equilibrium with the aquifer, are no longer migrating, and if the exceeding portion of the plume resides within facility boundaries, additional actions may not be required as long as the landfill is closed and capped and there is no evidence to suggest additional leachate is entering the aquifer. In these cases, instead of ASD submittal, other options such as a Variance to set an Alternate Point of Compliance (APC) may be a more appropriate, less costly course of action to pursue.

VI - REPORT FORMAT

An ASD must be a stand-alone technical document that is certified by a qualified groundwater professional in accordance with *9 VAC 20-81-250.A.5.(a).* For the sake of consistency and to ensure an expeditious review, the information (technical content) of the ASD should be arranged in the order presented below. The sections discussed herein shall be considered standard technical content. ASD submissions that do not provide the standard technical content outlined herein are more likely to be found to be incomplete and requiring revision during the Department's technical review process. The Department also notes that there may be some site-specific instances where a facility's technical data may require additional information beyond that listed in these SI as a means of more fully characterizing the technical data available and conclusions derived thereof.

Cover Page – Provide the following information:

- Landfill Name and Permit #
- Landfill location
- DEQ Region
- Name & Address of the Consultant
- Date report submitted

Signature Page – Include the signature & seal (if applicable) of a qualified groundwater professional certifying the content & findings of the ASD.

Table of Contents – Specify the order of the report sections.

Executive Summary – Provide a brief summary of the following technical findings of the ASD:

- Date of initial exceedance and location(s) of impacted well(s)
- Description of exceeding constituent(s)
- Description of the ASD field activity(ies)
- Description of the ASD allowance applied to the suspect exceedance

Introduction – Discuss how the data gathered during the ASD is sufficient to support the approval criteria noted within *9 VAC 20-81-250.A.5.* Discuss, in general terms, how the work performed for the ASD serves to prove that the identified source to the suspect exceedance was caused by something other than the solid waste management unit. The report should describe any limitations, as well as definitions for any technical or laboratory terminology used. The report shall describe the QA/QC procedures used during ASD sampling if applicable.

Exceedance Nature and History – The ASD should describe the constituent(s) which triggered the need to perform the ASD and a discussion of any prior detections of the constituent(s), noting, if applicable, any apparent trends in constituent concentration data. Trend analysis should be conducted using all available sampling events from the affected well as long as at least 10 or more events are available. If applicable, discuss the physical characteristics of the constituent(s) (water solubility, density, biodegradability, presence in the native aquifer matrix, etc.). Discuss concurrent or previous detections of landfill constituents. If the Department issued an extension to the original submittal date, the extension and basis for it should be described in this section.

Field Investigation – Describe which of the allowances under *9 VAC 20-81-250.A.5* the facility has chosen to explore during the ASD process. Describe all the actions undertaken, including the installation of new soil/bedrock borings, monitoring wells (and drilling methods used), piezometers, or other temporary sampling points (and sampling methods used); geophysical surveys (the type of); sampling of groundwater, surface water (if applicable), private wells (if applicable); or any

other actions deemed necessary to obtain data sufficient to complete a successful ASD. Well completion diagrams, boring logs, surveyed elevation data, field forms and laboratory data sheets should be included as Appendices to the ASD.

Data Evaluation – Describe the statistical analysis used to evaluate the ASD sampling data and, if applicable, ASD sample verification results.

Conclusions & Supporting Evidence – Provide a summary of findings of the ASD to support one or more of the VSWMR allowances noted previously. If additional site work is proposed, it should be proposed herein for Department approval.

Figures – Provide at a minimum copies of the:

- USGS 7 1/2-minute topographic map - showing the site location.
- Recent aerial image of site and surrounding properties showing land use.
- Site Plan including topographic contours, structures, surface water features, a bar scale, north arrow, facility boundary, landfill footprint, and all monitoring wells or sampling points relevant to the ASD.
- Groundwater potentiometric map.
- Optional figures - geologic maps, geologic cross-sections, etc.

Appendices – Provide at a minimum:

- Boring logs for any ASD wells/borings.
- Field Sampling Sheets and Chain of Custody Records.
- All ASD-related Analytical Results.

VII - SUBMISSION TIMELINES

A successful ASD under 9 VAC 20-81-250.A.5 must be made within 90 days of the noted statistical exceedance. The owner/operator may petition the Director to extend the 90-day deadline for ASD approval based on good cause.

----REFERENCES CITED----

USEPA, 1991, Solid Waste Disposal Facility Criteria; Final Rule, Federal Register, vol.56, no.196, p.50978-51119.

USEPA, 1992, Groundwater Issue – Behavior of Metals in Soils, Office of Solid Waste and Emergency Response, EPA/540/S92/018, 25p.

USEPA, 1993, Solid Waste Disposal Facility Criteria – Technical Manual, Office of Solid Waste and Emergency Response, EPA/530/R93/017, 349p.

USEPA, 2009, Statistical Analysis of Groundwater Monitoring Data at RCRA facilities – Unified Guidance, EPA/530/R09/007.